INFLUENCING FACTORS TO ENABLE AUTOMATION OF WOOD FURNITURE PRODUCTION

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ABSTRACT

The wood furniture industry in Sweden has an identified need of technological development in order to stay competitive. Especially the necessity to focus on automation has been identified. In the industry there are often needs to handle large levels of customization at the same time as keeping the production effective. This requires flexible automation solutions, often described as automated equipment that can rapidly be reconfigured for new products.

Before automated applications are implemented in an industry there are issues to solve related to organisational, human and technological aspects. Based on this, the project - Flexible automation in manufacturing of laminated veneer products was initiated. The project is running since January 1, 2016 and is a two year national Swedish project. The aim of the project is to investigate challenges concerning automation in the wood furniture industry and especially focusing on bended laminated veneer products.

In the project a case-study with the aim of identifying factors important for successful automation implementation in an involved wood manufacturing industry was performed. Key persons and staff of the company were asked to tell their life stories and a process mapping of the production was conducted.

The results indicate a problematic relation between the management and the production staff, which partly can be referred to the shift from a family business to a private owned firm. Based on the process mapping, internal transport and handling are identified improvement areas. Productivity is disturbed by stops caused by processing residues and poorly defined materials. There is potential for improvement by adapting a process-oriented approach and defining the materials used.

The case–study confirms the need to consider organizational and human aspects in production before initiating production. The study concludes the need to consider the special aspects of the wood material in production development.

Keywords: industrial robot, laminated veneer products, production development, process development

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INTRODUCTION

From a manufacturing perspective wood furniture may be seen as an example of products with a large inherent complexity (see e.g. Culbreth et al. 1996). Furniture parts are often not simple rotational or prismatic shapes, the raw material is not homogenous, the surface often contain imperfections, wood is hygroscopic and machining processes can produce large pieces of scrap that must be handled and disposed of. All these aspects are identified by Culbreth et al. (1996) to contribute to the complexity of furniture products.

In Sweden the wood manufacturing industry plays a significant economical role. Today the industry has 31 000 direct employees and an export value of approximately 3 billion EUR (TMF 2015). Sandberg et al. (2014) further show that furniture products is the wood product that contributes with the highest added value to the raw material. This product is followed by joinery. In Sweden as well as in other countries the wood manufacturing sector is unfortunately performing below manufacturing average (see e.g. Sowlati and Vahid, 2006). Furthermore, the industry is historically slow in engaging in activities increasing its efficiency (Pirraglia et al., 2009; Bumgardner et al, 2005; Sowlati and Vahid, 2006). In a Swedish long term perspective this is threatening and there is a great need to improve the industries performance to stay competitive both in relation to other countries as well as other materials.

One way of improving the performance is to work with production development. In many furniture industries in Sweden there is a need to handle large levels of customization in the same time as keeping the production effective. Production development such as automation solution therefore requires flexibility to rapidly be reconfigured for different products. Use of robots as a part of the production system may be a possible solution in order to obtain great flexibility together with effectiveness. Robots may contribute with rapidity, repeatability, and accuracy (e.g. Andersson 2011). With increasing computer capacity and improved intelligence such solutions may be a part of the production system also in manufacturing processes with high degree of customisation, and industries’ need of small order sizes.

Implementation of new technical solutions in the furniture industry is, however, challenging from other aspects than the technical ones. Winroth et al. (2007) mean that the quality management system should be supportive to the technology level chosen. The skill level of the personnel further needs to be considered as wells as authority levels and systems production planning and control.

To handle wood in these production systems will, as indicated, be challenging. Not only have different wood pieces different characteristics. Also the characteristics within the material vary and will change in relation to surrounding conditions e.g. due to changes in relative humidity.

To work on automation aspects in the wood furniture industry the project - Flexi-
ble automation in manufacturing of laminated veneer products was initiated. The project is running since January 1, 2016 and is a two year national Swedish project. The aim of the project is to investigate challenges concerning automation in the wood furniture industry. The project especially focuses on bended laminated veneer products. Blomqvist (2015) has shown that the manufacturing of bended laminated veneer products is a very complex process. The interaction between the materials and process parameters strongly influences the properties of the final product. To receive a good result the skilled craftsmen today have a great importance in matching the different veneers in relation to their characteristics. If considering automation of the process these aspects must be handled and fully understood. In the project a traditional wood manufacturing industry, together with academia and a company delivering fully integrated automation solutions, work together. The project is financed by The Knowledge Foundation.

This paper reports on initial results from the project with the aim of identifying factors important for successful automation implementation in an involved wood manufacturing industry.

**MATERIAL AND METHODS**

The study was performed as an industrial case study within a company manufacturing bended laminated veneer products for the furniture and joinery industry. Data collection was made through collecting life stories together with a process mapping of one production line in the factory.

**Life stories as methodology**

22 key persons were picked out from the criteria of length of employment and experience from change. The attendants were asked to tell their life story out from their position in the firm and were given a free choice to talk about whatever they found interesting or critical (Johansson, 2005). Extra questions were asked on topics about *family business*, *change* and *use of robots*. The length of the stories varied from 30-75 minutes. The methodological choice of life stories was based on an inductive approach with an interest of getting to know the individuals’ thoughts about critical issues. Furthermore, life stories were used to spread light not only on *what* but *how* things are done (Gabriel, 2000). It could also be seen as a complement to process mapping and its focus on technical rather than human issues.

**Process mapping**

The process mapping was concentrated to one production line in the factory. This production line produces mainly one seat shell to a chair. The production line already contains a certain degree of automation and use of robots. However, possi-
bilities of development and improvement were identified. The process mapping was conducted to determine how that automation approach works in order to build further on the experiences of the company. It also contributed that the company’s largest customer required volume increases and lower prize.

RESULTS AND DISCUSSION

The results indicate a problematic relation between the management and the production staff, which partly can be referred to the shift from a family business to a private owned firm. The former family business run by the father of the family with several positions occupied by family members complicates change. Problems arise when the production staff is used to management that both has the knowledge and interferes in every day details. This is quite opposite to the new management, which by the employees is experienced to have all their focus on sales figures without considering the possibilities of producing the forecasted volumes. This problem is, however, understood by the management and efforts have been made to employ a factory manager with a technical expertise. The hiring process has unfortunately been slow.

The shift in leadership furthermore results in a change of the staff’s actions: e.g. declined responsibility and initiative as well as feelings of no longer required efforts that earlier was a part of the family business system (Hall & Melin, 2012). All respondents are, however, welcoming new investments and increased levels of automation. Related to the work culture there is among the production staff an unwillingness to share knowledge about working procedures. Based on the process mapping, internal transport and handling are identified areas with potential for improvement. Moreover, the flow through the factory is hampered by poor cleanliness, workplace appearance and unstructured interim storages. The plant needs to be straightened up and improved concerning structure. Productivity is disturbed by stops caused by processing residues and poorly defined materials. There is a large potential for improvement by adapting a more process-oriented approach and defining the materials used in the products.

Implementation of industrial robots

Both Ahmad and Sullivan (1993) and Nof (1999) describe the importance of clear communication and good collaboration between management and production personnel in regards to introduction and implementation of new automatic equipment. It is necessary by the management to explain thoroughly why and how the implementation of automation equipment is thought to take place. Without good communication a very common demeanor is that workers often believe that industrial robots will take over their tasks and duties and on the long run run their positions. This can cause bad working climate and a loss in production efficiency.
However, as the results of the interviews indicate, the often displayed common disregard of new machinery acceptance of robotic automation in production is not the case for production personnel in this company. Partly because there are already well functioning robot cells available and workers have understood the importance of the equipment for production capacity, and the company’s future overall. Nevertheless, successful implementation of new industrial robot cells might be hindered through workers attitude or the employees’ feelings of not being involved in the decision making process. In addition, implementation is also slowed down by process problems, e.g. unstructured interim storages and the overall cleanliness of the working place.

CONCLUSIONS

The conducted case study confirms the need to consider organizational as well as human aspects in production before considering initiating production changes or automation implementation. It also shows that the shift from a family business to a private firm is complicated with special regards to human actions and feelings. The study furthermore concludes the need to consider the special aspects of the wood material concerning production development.

REFERENCES


